REMARKS/ARGUMENTS

This reply is being submitted together with a Request for Continued Examination. A Declaration pursuant to 37 C.F.R. §1.132 also accompanies this reply.

The Official Action dated June 3, 2003 and referenced cited therein have been carefully reviewed. In view of the amendments and additional evidence submitted herewith and the following remarks, favorable reconsideration and allowance of this application are respectfully requested.

Status of the prosecution:

The June 3, 2003 Official Action is a final rejection. The Action notes receipt of Applicants' amendment filed March 4, 2003, and states that any rejections not specifically addressed in the Action have been withdrawn in view of Applicants' amendments and/or arguments. Claims 1, 4-9 and 16-19 are pending and were examined.

Claims 1, 5-7 and 17 remain rejected or stand newly rejected under 35 U.S.C. §112, second paragraph, for alleged indefiniteness with respect to recitation of markers by designations deemed "non-art recognized."

Claims 1, 4-7 and 16-19 remain rejected or stand newly rejected under 35 U.S.C. §112, first paragraph, for alleged lack of adequate written description.

Claims 1, 4-7 and 16-19 remain rejected or stand newly rejected under 35 U.S.C. §112, first paragraph, for alleged lack of enablement.

Claim 1, 4, 6 and 16-18 remain rejected or stand newly rejected under 35 U.S.C. §102(b) as allegedly anticipated by the disclosure of Schumann et al. (1991) taken with the evidence of Naess et al. (2000).

Current amendments to the claims:

Claims 4, 7 and 18 are canceled herein. Claims 1, 5, 17 and 19 are currently amended. Support for the amendments can be found in the specification. No new matter has been added. Applicant asserts that the claims as amended are in condition for allowance, for the reasons set forth below.

The claims as amended meet all requirements under 35 U.S.C. §112, second paragraph:

Claims 1, 5-7 and 17 have been rejected for alleged indefiniteness on the ground that the markers recited therein are designated solely by a purportedly non-art-recognized designation. Though the applicants continue to disagree with the grounds for this rejection, claims 1 and 17 have been amended to recite that the markers comprise DNA segments that hybridize with any of SEQ ID NO:S 1-5 or their complementary sequences. Applicants respectfully assert that the metes and bounds of the invention as presently claimed are clear and that the claims meet all requirements under 35 U.S.C. §112, second paragraph. Withdrawal of the rejection is therefore requested.

The claims as amended meet all requirements under 35 U.S.C. §112, first paragraph:

Claims 1, 4-7 and 16-19 stand rejected under 35 U.S.C. §112, first paragraph, for alleged lack of adequate written description in the specification. This rejection is based on the assertion that the specification does not describe (1) the composition or structure of the late blight resistance gene on chromosome 8 of *S. bulbocastanum*; (2) late blight-resistant potato plants having incorporated the relevant portion of *S. bulbocastanum* chromosome 8 by traditional breeding methods; and (3) RFLP markers CT148, CT252 and CT68. Therefore, the specification is deemed not to adequately describe the invention as claimed. Applicants traverse this rejection as applied to the claims as amended.

Claims 4 , 7 and 18 have been canceled. The remaining claims are drawn to a late blight-resistant potato plant comprising a segment of chromosome 8 of the genome from *Solanum bulbocastanum* which comprises a gene that confers the resistance to late blight. The specification describes the claimed subject matter by disclosing the mapping of one genetic source of late blight resistance in *S. bulbocastanum* to chromosome 8, and its association with at least two RAPD markers and five RFLP markers, the physical sequences of which are either disclosed in the specification or are readily available in the literature (the latter being the case for RFLPS CT148, CT252 and CT68). The specification further discloses the production of somatic hybrids of *S. tuberosum* and *S. bulbocastanum* and numerous backcross progeny thereof, wherein the presence of late blight resistance is at least 95% correlated with the presence of one or more of the RAPD or RFLP markers.

Accordingly, the skilled artisan can envision the claimed structure (i.e., the potato plant) in accordance with the specification and would understand that the inventors were in possession of the claimed invention at the time of filing. Sufficient information has been conveyed in the present specification such that those of skill in the art would recognize the description of the late blight-resistant potato plants as claimed. In particular, the specification discloses functional information, as well as structural information required for the skilled artisan to correlate the function with known structures – i.e., the presence of the relevant portion of *S. bulbocastanum* chromosome 8 as evidenced by one or more linked RAPD or RFLP markers.

Claims 1, 4-7 and 16-19 also stand rejected under 35 U.S.C. §112, first paragraph, for alleged lack of enablement. The examiner has set out claimed subject matter deemed enabled by the specification, namely, potato plants produced by somatic hybridization between *S. tuberosum* and *S. bulbocastanum*. However, the examiner has deemed the specification not to enable either (1) transgenic potato plants or (2) plants produced by conventional breeding techniques, which contain the relevant portion of *S. bulbocastanum* chromosome 8. The examiner has further deemed claims 5 and 19 to lack enablement on the ground that "there is no teaching in the instant specification that the taught potato somatic hybrids are resistant to potato early blight, *Erwinia* soft rot or *Verticillium* wilt." Applicants respectfully traverse this rejection and assert that the claims as amended are fully enabled.

Claim 7, drawn to a transgenically produced plant, has been canceled. Claims 5 and 19 have been amended to recite resistance to potato early blight and *Verticillium* wilt. The present specification teaches a late blight-resistant potato plant produced by a combination of (1) somatic hybridization between *S. tuberosum* and *S. bulbocastanum* and (2) traditional breeding methods comprising backcrossing with *S. tuberosum* and selecting progeny having disease resistance co-segregating with a physical marker comprising a RFLP or RAPD fragment sequence associated with the relevant portion of *S. bulbocastanum* chromosome 8. The specification further teaches that these somatic hybrids and their progeny were resistant to potato early blight and *Verticillium* wilt, as well as late blight (page 23, lines 5-22). Thus, the specification has met the enablement requirement of teaching a mode of making and using the invention as presently claimed.

Applicants' assertions regarding the adequacy of written description and enablement of the claims is supported by the Declaration of co-inventor John P. Helgeson, submitted

herewith. As stated by Dr. Helgeson in paragraphs 8-10 of his Declaration, there are several reasons why one of skill in the art would recognize that the inventors were in possession of the invention at the filing date, and would be enabled to practice the invention through study of the specification. These include (1) teaching within the specification of how to make the claimed potato plants and discern that they contain the relevant portion of *S. bulbocastanum* chromosome 8, (2) the fact that RAPD and RFLP markers define physical locations within a chromosome of a given plant species and can be used to pinpoint the physical location of genes that co-segregate with them, (3) teaching in the specification that plants produced by the described methods were also resistant to early blight and *Verticillium* wilt, and (4) the fact that the RAPD and RFLP markers identified and used in the invention also proved to be useful for cloning the late blight resistance gene from *S. bulbocastanum* chromosome 8.

For all of the foregoing reasons, it is asserted that the presently amended claims are adequately described and fully enabled by the specification. Accordingly, withdrawal of all rejections under 35 U.S.C. §112, first paragraph, is requested.

The claimed subject matter is novel over the cited prior art:

Claims 1, 4, 6 and 16-18 stand rejected under 35 U.S.C. §102(b) as allegedly anticipated by Schumann et al., disclosing a somatic hybrid potato plant produced by fusion of protoplasts isolated from *S. tuberosum* and *S. bulbocastanum* and exhibiting improved resistance against late blight, in light of the evidence set forth by Naess et al., disclosing that resistance in a *S. tuberosum – S. bulbocastanum* somatic hybrid potato is associated with *S. bulbocastanum* chromosome 8 and RFLP marker CT88 (SEQ ID NO:3). Based on Naess et al., Schumann et al. was deemed to inherently disclose all of the limitations of the rejected claims. The examiner has stated that the Applicants have provided no evidence that the somatic hybrids disclosed by Schumann et al. do not inherently comprise the same features as the claimed potato plants, and therefore the rejection has been maintained.

Applicants continue to traverse this rejection. As stated previously, the mere fact that the late blight-resistance in the hybrids disclosed by Naess et al. was traced to *S. bulbocastanum* chromosome 8 does not necessarily mean that the late blight resistance in the hybrids of Schumann et al. was conferred by any portion of *S. bulbocastanum* chromosome 8

or, for that matter, by *S. bulbocastanum* at all. Support for this assertion is provided by statements and experimental evidence discussed by Dr. John Helgeson in his Declaration submitted herewith.

First, at paragraphs 11 and 12 of his Declaration, Dr. Helgeson points out that the germplasms used by Schumann et al. were not disclosed, and that not all *S. bulbocastanum* germplasms contain the resistance-conferring gene on chromosome 8. Indeed, experimental evidence generated by Dr. Helgeson's laboratory revealed that one *S. bulbocastanum* germplasm conferred some "improved" resistance to late blight, but it was of a different type than that conferred by the DNA segment on chromosome 8, and did not contain the relevant portion of chromosome 8 identifiable by the presence of the RAPD and RFLP markers. Therefore, it would be impossible for one of skill in the art to know from what source the "improved" resistance of the Schumann et al. hybrids was derived.

Second, at paragraphs 13 and 14 of his Declaration, Dr. Helgeson points out that late blight resistance can also be found in certain germplasms of potato (*S. tuberosum*). Therefore, without knowing the source of potato used by Schumann et al., it would be impossible for one skilled in the art to determine if the "improved" resistance of the Schumann et al. hybrids arose from *S. tuberosum* or *S. bulbocastanum*. In contrast, the biological materials used in the present invention were clearly identified, and the disease-conferring portion of *S. bulbocastanum* chromosome 8 was linked to several identifiable markers, such that anyone of skill in the art could produce somatic hybrids and select progeny containing the chromosomal segment and exhibiting late blight resistance.

Third, at paragraph 15 of his Declaration, Dr. Helgeson points out that the hybrids disclosed by Schumann et al. were likely not even fertile, and therefore could not be used to produce disease resistant progeny as taught and presently claimed.

Considering the information set forth in Declaration of Dr. Helgeson, as well as the arguments previously asserted, it clearly cannot be said that the resistance observed in the hybrids of Schumann et al. necessarily arose from *S. bulbocastanum* chromosome 8. The fact that a certain characteristic may be present in the prior art is not sufficient to establish the inherency of that result or characteristic. MPEP §2112, citing *In re Rijckaert*, 9 F.3d, 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). Therefore, Schumann et al. cannot be

deemed to inherently disclose the claimed invention. Accordingly, the rejection under 35 U.S.C. §102(b) should be withdrawn.

Conclusion:

In view of the amendments and Declaration of John P. Helgeson submitted herewith and the foregoing remarks, the presently-pending claims are believed to be in condition for allowance. Applicants respectfully request early and favorable reconsideration and withdrawal of the rejections set forth in the June 3, 2003 Action, and allowance of this application.

Respectfully submitted,

Date: November 3, 2003

Janet E. Reed, Ph.D.
Registration No. 36,252

Woodcock Washburn LLP
One Liberty Place - 46th Floor
Philadelphia PA 19103
Telephone: (215) 568-3100
Facsimile: (215) 568-3439

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
John P. Helgeson, et al.

Confirmation No.: 6417

Application No.: 09/463,510

Group Art Unit: 1638

Filing Date: June 26, 2000

Examiner: Kruse, David H.

For: Germplasm and Molecular Markers for Disease Resistance in Potato

DECLARATION OF JOHN P. HELGESON PURSUANT TO 37 C.F.R. §1.132

I, John P. Helgeson, declare as follows.

1. I am a United States citizen residing at 809 Oneida Place, Madison, Wisconsin 53711.

2. I received a Bachelors degree in Botany from Oberlin College in 1957 and a Ph.D. degree in Botany from the University of Wisconsin in 1964. I was a NIH Predoctoral Fellow from 1962 to 1964. Additional details of my educational background are set forth in my *Curriculum vitae*, attached hereto.

3. From 1964-1966 I was a NSF Postdoctoral Fellow in the Department of Chemistry, University of Illinois. From 1966-1970, from 1970-1975 and from 1975-2002, respectively, I was an Assistant Professor, Associate Professor and Professor in the Department of Plant Pathology, University of Wisconsin. I am currently Professor Emeritus. From 1966-1990 I served as a Research Plant Physiologist, ARS, USDA, Madison, Wisconsin. From 1990-2002 I was Research Leader, USDA/ARS Plant Disease Resistance Unit. Additional details of my professional history are set forth in my *Curriculum vitae*.

4. I have had over thirty years of scientific training and research experience in the areas of Plant Physiology, molecular biology and biochemistry. I am the author, co-author or presenter of more than 85 scholarly publications and several recent invited lectures, as set forth in detail in my *Curriculum vitae*. I have participated in numerous scientific committees advisory boards and special assignments, including a Visiting Fellowship, Wolfson College and Botany School, University of Cambridge, UK, Program Manager, Biological Stress Program, USDA Competitive Grants, Visiting scientist, CNRA, INRA-Lab de Biologie Cellulaire, Versailles, member and Chairman University of Wisconsin Institutional Biosafety Committee and Biotron Advisory Committee, and Faculty Director, University of Wisconsin Biotech Center Plant Biotech Facility.

5. My current areas of research focus on the physiology and chemistry of plant growth substances, development and utilization of model tissue culture systems for studying disease resistance mechanisms, development of tissue culture methods and techniques for somatic hybridization of potato and wild *Solanum*, evaluating disease resistances obtained from wild *Solanum* species through somatic hybridization, and molecular analyses of DNA introgression from wild species into cultivars, including mapping and cloning a late blight resistance gene from *Solanum bulbocastanum*.

6. I am a co-inventor of the subject matter covered in the above-referenced U.S. Patent Application Serial No. 09/463,510, entitled "Germplasm and Molecular Markers for Disease Resistance in Potato" (referred to hereinafter as "the present application"), claims 1, 4-9 and 16-19 of which are currently under final rejection in the U.S. Patent and Trademark Office.

7. I have read and am familiar with the Official Action dated June 3, 2003 in the present application. I understand the nature of the rejections made by the examiner concerning alleged lack of written description and enablement, and lack of novelty of the claimed invention. I disagree with the examiner that our invention lacks novelty or is inadequately described, for at least the reasons discussed in the following paragraphs.

8. The examiner states that the present application does not adequately describe or enable practice of the invention that is claimed. The examiner contends that we cannot make a late blight-resistant potato plant that contains a resistance-conferring segment of chromosome 8 of the genome from *Solanum bulbocastanum*, without actually having isolated the resistance-conferring gene. This is most emphatically not the case. As has been emphasized previously, and has been taught in our patent application, we indeed have actually produced late blight-resistant potato plants through (1) somatic hybridization between *S. tuberosum* and *S. bulbocastanum* and (2) backcrossing with *S. tuberosum* and selecting progeny having disease resistance co-segregating with a physical marker comprising a RFLP or RAPD fragment sequence associated with the relevant portion of *S. bulbocastanum* chromosome 8. Resistance to late blight in these plants correlates 95% or better with the presence of one or more of the RAPD or RFLP markers. Since sequences for those markers are either described in our application or available in the literature, anyone skilled in plant tissue culture and breeding would be able to make late-blight-resistant potato plants. Thus, we show the public that we made our invention as claimed, and we teach the public how to practice our invention. Furthermore, our applications sets forth evidence that potato plants made by our methods are also resistant to potato early blight and *Verticillium* wilt.

9. Part of the reason for the examiner's rejection seems to rest on his contention that "RAPD and RFLP markers only describe a chromosomal location," and "the CT88 RFLP marker describes a chromosomal location of Solanaceous plants other than potato, such as tomato and eggplant." I disagree with this assessment. RFLP and RAPD markers actually mark physical locations on chromosomes having sequences to which they hybridize. It is understood that the specific physical locations identified by those markers differ from species to species. It is true that plants of the Solanaceae family (potato, eggplant, pepper, and potato) do indeed have somewhat similar genomes. There may be as much as 95% similarity of base alignment in the genomes, although sometimes whole chromosome arms are inverted. This has made it possible to use various tomato markers to map other species in the genus, but the mapping must be done in each of the species as the genomes are not identical. The markers may be on the same chromosome but even this must be determined. Thus CT88 (a

tomato RFLP marker) can be used in potato to unambiguously determine one spot on potato chromosome 8, but the spot is not exactly the same as that on chromosome 8 of tomato. Each spot is unique to the species considered. Since a diploid potato may have nearly as much DNA as a human, and only 24 chromosomes to spread the DNA among, it is clear that differences can be logically deduced, and actually found. RAPD markers, on the other hand, are species specific. They are 10mers that result in the amplification of DNA of corresponding structure. For each species, it is necessary to establish that the RAPD marker is actually amplifying DNA from a given chromosome. This, in fact, is how we used RFLPS and RAPDs to establish unique mapping locations on the chromosomes of *S. bulbcastanum*. Thus the sequence amplified in response to GO_2 (a marker of known sequence of 10 bases that can be obtained from Operon technologies by anyone) will not map to the same spot in the genome in potato as compared to tomato. Nonetheless, once mapped in *S. bulbocastanum*, both RAPD and RFLP markers can be used to pinpoint the physical location of genes that co-segregate with them.

10. To further emphasize the value of our RAPD and RFLP markers in delineating the physical location of late blight resistance gene on *S. bulbocastanum* chromosome 8, it must also be noted that we have used those markers to actually clone the gene, which we have inserted it into a susceptible potato and have shown that it makes the potato resistant to late blight (*See* Song et al., Proc. Natl. Acad. Sci. USA 2003 100: 9128-9133, copy attached). Our germplasm and markers are thus not only valuable for marker-assisted breeding, they have also provided essential tools for mapping the relevant location of *S. bulbocastanum* chromosome 8 and isolating the late blight resistance gene.

11. The examiner has also stated that our invention is not novel due to the previous publication of an abstract by Schumann et al. in 1991, when taken in light of our publication by Naess et al. in 2000. The examiner takes the position that Schumann et al., which discloses only that an unspecified somatic hybrid of *S. bulbocastanum* and *S. tuberosum* showed an "improved" resistance against *P. infestans*, must inherently contain the resistance-conferring gene found on chromosome 8 of the *S. bulbocastanum* described by Naess et al. nine years later. This is truly not the case. Foremost, the authors present no data nor did they

follow this report with a publication. Thus there is no scientific basis for crediting their work with any sort of precedence, nor is it remotely possible to know what biological materials they were actually working with. Accordingly, a plant biologist would not have any reason to believe that the material described by Schumann et al. would contain any particular resistance gene, and certainly not the one we have identified. Support for why this is true is presented below.

12. First, Schumann et al. did not specify which germplasms were used in their somatic hybridization. Therefore, without clear specification of an identifiable accession or source, no person can know that the authors actually used *S. bulbocastanum* or, if they did do so, which line of the many available. For example, the catalogue of the North American genebank on *Solanum* species lists 40 different accessions of *S. bulbcastanum*. These differ in their characteristics. Some, for example, are resistant to various diseases, others are susceptible etc. (see Hanneman, R. E and Bamberg, bulletin 533 of the Wisc. Ag. Experiment Station, 1986). Therefore, not all accessions of *S. bulbocastanum* are identical. We have worked with two of these accessions. One is PI 243510 (We selected a single seeding from this group, designating it PT29. This clone has the resistance gene on chromosome 8 that was mapped in the Naess et al paper.) Another accession, PI 275187 selection # 10, designated in our lab as SB22) was also used in somatic hybridization, this time to achieve resistance to a nematode (Austin et al, Amer. Potato J. 70 485-495 (1993). After finding that somatic hybrids with PT 29 were resistant to late blight (Helgeson et al, 1998) we also tested those obtained with SB22 and found that they also were resistant, although not as strikingly so as the hybrids with PT 29. Subsequently, in unpublished work, we found (using our RAPD and RFLP markers) that SB22 lacks the resistance gene from chromosome 8. Also, we have found that, in field tests, progeny from the somatic hybrid with SB 22 shows a classic QTL (quantitative trait locus) pattern of resistance and susceptibility, a different pattern from that shown by the resistance that originally came from the PT29 isolate that carries the chromosome 8 gene. This indicates that any disease resistance that might have been conferred by *S. bulbocastanum* in the Schumann et al. hybrids was not conferred by the gene on chromosome 8 as described by Naess et al.

13. Second, Schumann et al. also did not specify which clone of potato (*S. tuberosum*) was used in the fusion. Therefore one cannot know if they had used a potato that actually carried resistance to late blight – and some of them do carry late blight resistance. Why is this important? For example, we reported in 1986 (Helgeson et al., Plant Cell Reports 3: 212-214) that somatic hybrids between *Solanum brevidens* (PI218228) and a potato clone PI 203900 were resistant to race 0 of *Phytophthora infestans* but susceptible to a race 1,2,3,4 genotype of the fungus. We expected this as we had selected the potato line because of its known resistance to race 0 and susceptibility to *P. infestans* races carrying the R4 gene. The *S. brevidens* accession was susceptible to late blight but resistant to potato leaf roll virus. The somatic hybrids were resistant to PLRV AND Race 0 of late blight but susceptible to race 1,2,3,4 of late blight. Both genotypes of the fungus had to be tested in order to determine the source of the resistance and to determine that resistances from BOTH species could be expressed in the somatic hybrid. The point to be made is that we do not know if the late blight resistance reported by Schumann et al actually came from the *Solanum bulbocastanum* clone - it could have come from potato. Furthermore, Schumann et al. did not specify what genotype (isolate) of the late blight fungus was used to test for resistance. Thus there is no basis for knowing whether their report of resistance should have any credence, or any relationship to the resistance gene from chromosome 8.

14. In contrast, fungal materials, the accession and clone of *S. bulbcastanum* and the potato materials that was used in the present application and in the mapping studies by Naess et al are clearly identified, along with the actual data showing plant testing. Furthermore, our pioneering work led to the identification of molecular markers that can now be used to clearly determine whether or not a particular accession of *S. bulbocastanum* contains the resistance-conferring segment on chromosome 8 – something that simply could not have been predicted or even suspected by reading the Schumann et al. abstract.

15. Furthermore, there is no evidence presented in the Schumann et al. abstract that they obtained fertile somatic hybrids, which is key to using this technology. Indeed since they appear to have fused *S. bulbocastanum* with a chlorophyll deficient potato mutant, their chances of recovering fertile hybrids would have been low. Without fertility, it is impossible

to derive segregating populations and therefore map the location of the resistance. This is just one more reason, which combined with all the reasons described above, why one skilled in the relevant technical field would not believe that the plants described by Schumann et al. would necessarily possess the chromosome 8 resistance-conferring segment that we describe and claim in our patent application.

16. For at least the reasons set forth above, I am of the opinion that our patent application describes the invention we have claimed, and teaches people of skill in the relevant technical field how to practice the invention. I am further of the opinion that our invention represents a significant advance in the field of potato breeding, genetics and disease resistance, and is novel over anything previously published or available.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-referenced application or any patent issued thereon.

Oct 29, 2003
DATE

JOHN P. HELGESON

***Curriculum Vitae*: John P. Helgeson**

Office address:

789A Russell Laboratories
Department of Plant Pathology
University of Wisconsin
Madison, WI 53706
Telephone (608) 262-0649
FAX (608) 262-1541

Home address:

809 Oneida Place
Madison, WI 53711
Telephone: (608) 233-7760
E-mail Jphelges@facstaff.wisc.edu

Higher Education:

1957 A.B. - Oberlin College (Botany)
1964 Ph.D. - University of Wisconsin (Botany)

Employment and Research Experience:

1960-1962 - Research Assistant, Dept. of Botany, University of Wisconsin
1962-1964 - NIH Predoctoral Fellow, Dept. of Botany, Univ. of Wisconsin
1964 -1966 - NSF Postdoctoral Fellow, Department of Chemistry, Univ. of Illinois.
1966 -1970 - Assistant Professor, Dept. of Plant Pathology, Univ. of Wisconsin
1970 -1975 - Assoc. Professor, Dept. of Plant Pathology, Univ. of Wisconsin
1975 -2002 - Professor, Dept. of Plant Pathology, Univ. of Wisconsin
1966 -1990 - Research Plant Physiologist, ARS, USDA, Madison, WI.
1990 -2002 - Research Leader, USDA/ARS Plant Disease Resistance Research Unit
2003- Professor Emeritus, Dept. of Plant Pathology, Univ. of Wisconsin

Special Assignments:

1979 - Visiting Fellow, Wolfson College and Botany School, Univ. of Cambridge, UK.
1982-1983 Program Manager, Biological Stress Program, USDA Competitive Grants.
1985-1986 Visiting scientist, CNRA, INRA-Lab de Biologie Cellulaire, Versailles.
1987-1991 Member , UW Institutional Biosafety Committee.
1991-1993, Chairman, UW Institutional Biosafety Committee.
1991-1993 Chairman UW Biotron Advisory Committee.
1986-2002, Faculty Director, UW Biotech Center Plant Biotech Facility.

Recent Invitations:

Symposium Speaker, Phytophthora 151, Guadalahara, Mexico, Sept 1996
Symposium speaker, North Amer. Late Blight Conference, Tucson, AZ, January 1997
Invited Symp speaker, IX Congress on Tissue and Cell Culture, Israel, June, 1998.
Invited participant, CEEM meeting on Late blight, August, 2000, Toluca Mexico
Invited participant, Collaborative Workshop on Late blight, June, 2001, Warsaw, Poland
Invited Symposium speaker, GILB 2002, Hamburg, Germany, July 2002

Fields of Research Interest:

a. Physiology and chemistry of plant growth substances including isolation, characterization, analysis and structure/activity relationships of cytokinins and factors controlling tissue culture growth rates and yields.

b. Development and untilization of model tissue culture systems for studying disease resistance mechanisms

c. Develpment of tissue culture methods and techniques for somatic hybridization of potato and wild Solanum

d. Evaluating disease resistances obtained from wild Solanum spieces through somatic hybridization.

e. Molecular analyses of DNA introgression from wild species into cultivars including mapping and cloning a late blight resistance gene from *Solanum bulbocastanum*

Publications other than abstracts

1. Helgeson, J. P. Preparation from peas with high kinetin-like activity. University of Wisconsin. 1964. (Ph.D. Thesis).

2. Rogozinska, J. H., Helgeson, J. P., and Skoog, F. Tests for kinetin-like growth promoting activities of triacanthine and its isomer, 6-(g,g-dimethyallylamino)purine. Physiologia Plantarum. 17:165-176. 1964.
3. Leonard, N. J., Carraway, K. L., and Helgeson, J. P. Characterization of N_xN_y-disubstituted adenines by ultraviolet absorption spectra. J. of Heterocyclic Chemistry. 2:291-297. 1965.

4. Rogozinska, J. H., Helgeson, J. P., Skoog, F., Lipton, S. H., and Strong, F. M. Partial purification of a cell-division factor from peas. Plant Physiology. 40:469-476. 1965.

5. Helgeson, J. P., and Leonard, N. J. Cytokinins: Identification of compounds isolated from *Corynebacterium fascians*.Proceedings Natl. Acad. Sci. 56: 60-63. 1966.

6. Skoog, F., Hamzi, H. Q., Szweykowska, A. M., Leonard, N. J., Carraway, K. L., Fujii, T., Helgeson, J. P., and Loeppky, R. N. Cytokinins: Structure/activity relationships. Phytochemistry. 6:1169-1192. 1967.

7. Carraway, K. L., Rasmussen, M., and Helgeson, J. P. Cyclization of N-(3-methyl-2-butenyl)adenine at the 1-position, *In* Wiley (ed.), Synthetic Procedures in Nucleic Acid Chemistry, Zorbach, W. W., New York pp. 529-531. 1968. (Book Chapter)

8. Hecht, S. M., Helgeson, J. P., and Fujii I, R. N-(3-methyl-2- butenyl)-adenine. Combination of 6-chloropurine with a primary amine, *In* Wiley (ed.), Synthetic Procedures in Nucleic Acid Chemistry, Zorbach, W. W., New York pp. 8-10. 1968. (Book Chapter)

9. Helgeson, J. P. The Cytokinins. Synthetic and naturally occurring N^6-substituted adenine derivatives profoundly affect plant growth. Science. 161:974-981. 1968.

10. Dropkin, V. H., Helgeson, J. P., and Upper, C. D. The hypersensitivity reaction of tomatoes resistant to *Meloidogyne incognita*: Reversal by cytokinins. J. of Nematology. 1:55-61. 1969.

11. Helgeson, J. P., Krueger, S. M., and Upper, C. D. Control of logarithmic growth rates of tobacco callus tissue by cytokinins. Plant Physiol. 44:193-198. 1969.

12. Helgeson, J. P., and Upper, C. D. Modification of logarithmic growth rates of tobacco callus tissue by gibberellic acid. Plant Physiol. 46:113-117. 1970.

13. Upper, C. D., Haberlach, G. T., and Helgeson, J. P. Limitation of tobacco callus growth by carbohydrate availability. Plant Physiol. 46:118-122. 1970.

14. Upper, C. D., Helgeson, J. P., Kemp, J. D., and Schmidt, C. J. Gas-liquid chromatographic isolation of cytokinins from natural sources. Plant Physiol. 45:543-547. 1970.

15. Helgeson, J. P., Kemp, J. D., Maxwell, D. P., and Haberlach, G. T. A tissue culture system for studying disease resistance: the black shank disease in tobacco callus cultures. Phytopathology. 62:1439-1443. 1972.

16. Helgeson, J. P., Upper, C. D., and Haberlach, G. T. Medium and tissue sugar concentrations during cytokinin-controlled growth of tobacco callus tissues, *In* D. J. Carr (ed.), Plant Growth Substances, Springer Verlag pp. 484-492. 1972. (Book Chapter)

17. Upper, C. D., Helgeson, J. P., and Schmidt, C. J. Identification of cytokinins by gas-liquid chromatography and gas-liquid chromatography-mass spectrometry, *In* D. J. Carr (ed.), Plant Growth Substances pp. 798-807. 1972. (Book Chapter)

18. Helgeson, J. P., Haberlach, G. T., and Vanderhoef, L. N. T-2 toxin decreases logarithmic growth rates of tobacco callus tissues. Plant Physiol. 52:660-662. 1973.

19. Stahl, C., Vanderhoef, L. N., Siegel, N., and Helgeson, J. P. *Fusarium trincinctum* toxin inhibits auxin-promoted elongation in soybean hypocotyl. Plant Physiol. 52:663-666. 1973.

20. Helgeson, J. P., Haberlach, G. T., and Hecht, S. M. On the inhibition of tobacco callus and suspension culture growth by pyrazolo (4,3-d)pyrimidine analogs of cytokinins, *In* S. Tamura (ed.), Plant Growth Substances, Hirokawa, Tokyo pp. 485-493. 1974. (Book Chapter)

21. Zalewski, J. C., Helgeson, J. P., and Kelman, A. A method for large scale laboratory inoculation of potato tubers with late blight fungus. Am. Potato J. 51:403-407. 1974.

22. Helgeson, J. P., Haberlach, G. T., and Upper, C. D. A dominant gene conferring disease resistance to tobacco plants is expressed in tissue cultures. Phytopathology. 66:91-96. 1976.

23. Allen, J. R., Marlar, R. J., Chesney, C. F., Helgeson, J. P., Weckel, K. G., Kelman, A., Traisman, E., and White, J. W., Jr. Teratogenicity studies on late blighted potatoes in nonhuman primate (Macaca mulatta and Saguinus labiatus). Teratology. 15:17-23. 1977

24. Corcuera, L. J., Woodward, M. D., Helgeson, J. P., and Upper, C. D. 2,4-Dihydroxy-7-methoxy-2H-1,4-benzoxazin-3(4H)- one, an inhibitor from *Zea mays* with differential activity against soft rotting *Erwinia species*. Plant Physiol. 61:791-795. 1978.

25. Haberlach, G. T., Budde, A. D., Sequeira, L., and Helgeson, J. P. Modification of disease resistance of tobacco callus tissue by cytokinins. Plant Physiol. 62:522-555. 1978.

26. Helgeson, J. P. Alteration of growth by disease, *In* Horsfall and Cowling (ed.), Plant Disease:
An Advanced Treatise Vol. III, Academic Press pp. 183-200. 1978. (Book Chapter)

27. Woodward, M. D., Corcuera, L. J., Helgeson, J. P., Kelman, A., and Upper, C. D. Factors that influence the activity of 2,4- dihydroxy-7-methoxy-2H-1,4-benzoxazin-3(4H)-one on *Erwinia* species in growth assays. Plant Physiol. 61:803-805. 1978.

28. Woodward, M. D., Corcuera, L. J., Helgeson, J. P., and Upper, C. D. Decomposition of 4-dihydroxy-7-methoxy-2H-1,4-benzoxazin- 3(4H)-one in aqueous solutions. Plant Physiol. 61:796-802. 1978.

29. Helgeson, J. P. Tissue and cell suspension culture, *In* R. D. Durbin (ed.), *Nicotianae:* Procedures for Experimental Use, USDA Tech. Bull.1586. pp. 52-59. 1979. (Book Chapter)

30. Woodward, M. D., Corcuera, L. J., Helgeson, J. P., Kelman, A., and Upper, C. D. Quantitation of 1,4-benzoxazin-3-ones in maize by gas-liquid chromatography. Plant Physiol. 63:14-19. 1979.

31. Woodward, M. D., Corcuera, L. J., Schnoes, H. K., Helgeson, J. P., and Upper, C. D. Identification of 1,4-benzoxazin-3-ones in maize extract by gas-liquid chromatography and mass spectrometry. Plant Physiol. 63:9-13. 1979.

32. Helgeson, J. P. Concluding discussion: Challenges for the future, *In* D. Ingram and J. Helgeson (ed.), Tissue Culture Methods for Plant Pathologists, Blackwell Scientific Publications, Ltd., Oxford pp. 261-263. 1980. (Book Chapter)

33. Helgeson, J. P. Plant tissue and cell suspension cultures, *In* D. Ingram and J. Helgeson (ed.), Tissue Culture Methods for Plant Pathologists, Blackwell Scientific Publications, Ltd., Oxford pp. 19-25. 1980. (Book Chapter)

34. Helgeson, J. P., and Haberlach, G. T. Disease resistance studies with tissue cultures, *In* D. Ingram and J. P. Helgeson (ed.), Tissue Culture Methods for Plant Pathologists, Blackwell Scientific Publications, Ltd., Oxford pp. 179-184. 1980. (Book Chapter)

35. Ingram, D. S., and Helgeson, J. P. (ed.). Tissue Culture Methods for Plant Pathologists. Blackwell Scientific Publications, Oxford. 1980. (Book)

36. Wilson, H. M., Styer, D. J., Conrad, P. L., Durbin, R. D., and Helgeson, J. P. Isolation of sterile protoplasts from unsterilized leaves. Plant Sci. Lett. 18:151-154. 1980.

37. Ursic, D., Kemp, J. D., and Helgeson, J. P. A new antibiotic with known resistance factors, G418, inhibits plant cells, Biochem. Res. Comm. 101:1031-1037. 1981.

38. deZoeten, G. A., Gaard, G., Haberlach, G. T., and Helgeson, J. P. Infection of tobacco callus by *Phytophthora parasitica* var. *nicotianae*. Phytopathology. 72:743-746. 1982.

39. Mellon, J. E., and Helgeson, J. P. Interaction of a hydroxyproline-rich glycoprotein from tobacco callus with potential pathogens. Plant Physiol. 70:401-405. 1982.

40. Helgeson, J. P. Studies of host-pathogen interactions *in vitro*, *In* J. P. Helgeson and B. Deverall (ed.), Use of Tissue Culture and Protoplasts in Plant Pathology, Academic Press, Australia. pp. 9-38. 1983. (Book Chapter)

41. Helgeson, J. P. Introduction, *In* J. P. Helgeson and B. Deverall (ed.), Use of Tissue Culture and Protoplasts in Plant Pathology, Academic Press, Australia pp. 1-7. 1983. (Book Chapter)

42. Helgeson, J. P., and Deverall, B. J. Use of Tissue Culture and Protoplasts in Plant Pathology. Academic Press, Australia. 1983. (Book).

43. Austin, A., Baer, M. A., and Helgeson, J. P. Transfer of resistance to potato leaf roll virus from *Solanum brevidens* into *Solanum tuberosum* by somatic fusion. Plant Sci. Lett. 39:7582. 1985.

44. Austin, S., Baer, M., Ehlenfeldt, M., Kazmierczak, P. J., and Helgeson, J. P. Intra-specific fusion in *Solanum tuberosum*. Theor. Appl. Genet. 71:172-175. 1985.

45. Haberlach, G. T., Cohen, B. A., Reichert, N. A., Baer, M. A., Towill, L. E., and Helgeson, J. P. Isolation, culture and regeneration of protoplasts from potato and several related *Solanum* species. Plant Sci. Lett. 39:67-74. 1985.

46. Austin, S., Ehlenfeldt, M., Baer, M., and Helgeson, J. P. Somatic hybrids produced by protoplast fusion between *S. tuberosum* and *S. brevidens*: phenotypic variation under field conditions. Theor. Appl. Genet. 71:682-690. 1986.

47. Helgeson, J. P., Hunt, G. J., Haberlach, G. T., and Austin, S. Somatic hybrids between *Solanum brevidens* and Solanum tuberosum: expression of a late blight resistance gene and potato leaf roll resistance. Plant Cell Reports. 3:212-214. 1986.

48. Austin, S., and Helgeson, J. P. Interspecific somatic fusions between *Solanum brevidens* and *S. tuberosum*, *In* D. von Wettstein and N. H. Chua (ed.), Plant Molecular Biology, Plenum Publishing Corp, N. Y. pp. 209-222. 1987.

49. Ehlenfeldt, M. K., and Helgeson, J. P. Fertility of somatic hybrids from protoplast fusions of *Solanum brevidens* and *S. tuberosum*. Theor. Appl. Genet. 7:395-402. 1987.

50. Farmer, E. C., and Helgeson, J. P. An Extracellular Protein from *Phytophthora parasitica* var. *nicotianae* is associated with stress metabolite accumulation in tobacco callus. Plant Physiol. 85:733-740. 1987.

51. Farmer, E. E., Uchytil, T. F., Helgeson, J. P., and Durbin, R. D. Chromatographic amino acid analysis of protein hydrolysis in polyacrylamide after removal of ammonia. Chromatographia. 23:115-117. 1987.

52. Austin, S., Lojkowska, E., Ehlenfeldt, M. K., Kelman, A., and Helgeson, J. P. Fertile interspecific somatic hybrids of *Solanum*: A novel source of resistance to *Erwinia* soft rot. Phytopathology. 78:1216-1220. 1988.

53. Helgeson, J. P., Haberlach, G. T., Pohlman, J., and Austin, S. Somatic fusions of *Solanum* species. Plant Cell, Tissue and Organ Culture. 12:185-187. 1988

54. Helgeson, J. P. Somatic hybridization of wild *Solanum* species with potato: a potential source of diversity for breeders, *In* K. Louwes, H. Toussant, and L. Dellart (ed.), Parental Line Breeding and Selection in Potato Breeding, Pudoc, Wageningen, The Netherlands pp. 87-94. 1989.

55. Helgeson, J. P. Post-harvest resistance through breeding and biotechnology. Phytopathology. 79:1375-1377. 1989.

56. Huang, Y., Helgeson, J. P., and Sequeira, L. Isolation and purification of a factor from *Pseudomonas Solanacearum* that induces a hypersensitive-like response in potato cells. Mol. Plant-Microb. Interact. 2:132-138. 1989.

57. Hunt, G. J., and Helgeson., J. P. A medium and simplified procedures for growing single cells from *Solanum* species. Plant Science. 60:251-257. 1989.

58. Austin, S., and Helgeson, J. P. Preparation of plant protoplasts, *In* Z. Klement, K. Rudolph, and D. C. Sands (ed.), Methods in Phytobacteriology, Akademiai Kiado, Budapest pp. 394-399. 1990.

59. Helgeson, J. P., and Austin, S. Plant tissue and suspension cultures, *In* Z. Klement, K. Rudolph, and D. C. Sands (ed.), Methods in Phytobacterioloy, Akademiai Kiado, Budapest pp. 391-394. 1990.

60. Helgeson, J. P., Haberlach, G. T., and Austin, S. Somatic fusion of *Solanum* species, an overview, *In* A. C. Torres and L. S. Caldas (ed.), Technicas e aplicacoes da cultura de tecidos de plantas: 2nd National Tissue Culture Symposium of Brazil, Embrapa, Brasilia pp. 333-340. 1990.

61. Williams, C. E., Hunt, G., and Helgeson, J. P. Fertile somatic hybrids of *Solanum* species: RFLP analysis of a hybrid and its sexual progeny from crosses with potato. Theor. Appl. Genet. 80:545-551. 1990.

62. Helgeson, J. P. New genes for disease resistances through somatic hybridization. Netherlands Journal of Plant Pathology. 98 suppl. 2:223-229. 1992.

63. Austin, S., Pohlman, J. D., Brown, C. R., Mojtahed, H., Santo, G. S., Douches, D. S., and Helgeson, J. P. Interspecific somatic hybrids between *Solanum tuberosum* and *S. bulbocastanum*: Incorporation of nematode resistance. Amer. Potato J. 70:485-495. 1993.

64. Helgeson, J. P. Application of protoplast fusion technology to potato disease management, *In* G. W. Zehnder, M. L. Powleson, R. K. Jansson, and K. V. Raman (ed.), Advances in Potato Pest Biology and Management, APS Press, St. Paul pp. 556-564. 1993. (Book Chapter)

65. Helgeson, J. P., Haberlach, G. T., Ehlenfeldt, M. K., Hunt, G., Pohlman, J. D., and Austin, S. Sexual progeny of somatic hybrids between potato and *Solanum* brevidens: potential for use in breeding programs. American Potato Journal. 70:437-452. 1993.

66. Kim, H., Choi, S. U., Chae, M. S., Wielgus, S. M., and Helgeson, J. P. Identification of somatic hybrids produced by protoplast fusion between *Solanum commersonii* and *S. tuberosum* haploid. Korean Soc. Plant Tissue Culture. 20:337-344. 1993.

67. McGrath, J. M., Wielgus, S. M., Uchytil, T. F., Kim-Lee, H., Haberlach, G. T., Williams, C. E., and Helgeson, J. P. Recombination of *Solanum brevidens* chromosomes in the second backcross generation from a somatic hybrid with *S. tuberosum*. Theor. Appl.Genet. 88:917-924. 1993.

68. Williams, C. E., Wielgus, S., Guenther, C., Haberlach, G. T., Kim-Lee, H., and Helgeson, J. P. RFLP analysis of chromosomal segregation in progeny from an interspecific hexaploid somatic hybrid between *Solanum brevidens* and *S.tuberosum*. Genetics. 135:1167-1173. 1993.

69. Novy, R. G., and Helgeson, J. P. Somatic hybrids between *Solanum etuberosum* and diploid, tuber-bearing *Solanum* clones. Theor. Appl. Genet. 89:775-782. 1994.

70. Novy, R. G., and Helgeson, J. P. Resistance to potato virus Y in somatic hybrids between Solanum etuberosum and a *S. tuberosum* x *S. berthaultii* hybrid. Theor. Appl. Genet. 89:783-786. 1994.

71. Presting, G. G., and Helgeson, J. P. Media and protocols for the isolation of independent mutants and transformants of *Nicotianae plumbaginifolia* protoplasts. Plant Science. 99:211-221. 1994.

72. McGrath, J. M., Wielgus, S. M., and Helgeson, J. P. Segregation and recombination of *Solanum brevidens* synteny groups in progeny of somatic hybrids with *S. tuberosum*: Intragenomic equals or exceeds intergenomic recombinations. Genetics. 142:1335-1348. 1996

73. Helgeson, J. P., Pohlman, J. D, Austin, S., Haberlach, G.T., Wielgus, S.M., Ronis, D., Zambolim, L., Tooley, P., McGrath, J.M. James, R.V., and Stevenson,W. R. Somatic hybrids between *Solanum bulbocastanum* and potato: a new source of resistance to late blight. Theor. Appl. Genet. 96-738-742. 1998

74. Limami, M.A, Sun, L-Y, Douat, C., Helgeson, J., and D. Tepfer. D. Natural genetic transformation by *Agrobacterium rhizogenes*. Annual flowering in two biennials, Belgian endive and carrot. Plant Physiol. 118:543-550. 1998.

75. McGrath, J.M. and Helgeson, J.P. Differential behavior of *Solanum brevidens* ribosomal DNA loci in a somatic hybrid and its progeny with potato. Genome 41: 435-439. 1998.

76. Bains, P.S., Bisht, V.S., Lynch, D.R., Kawchuk, L.M., and Helgeson, J.P.. Screening for stem rot of potato (*Erwinia carotovora* subspecies *atroseptica*) resistance. Amer. Potato J. 76: 137-141.1999.

77. Chen, Y.H., Palta, J.P., Bamberg, J.B., Kim, H., Haberlach, G.T., and Helgeson, J.P. Expression of nonacclimated freezing tolerance and cold acclimation capacity in somatic hybrids between hardy wild *Solanum* species and cultivated potatoes. Euphytica 107: 1-8. 1999.

78. Dong, F., Novy, R.G., Helgeson, J.P., and Jiang , J. Cytological characterization of potato-*Solanum etuberosum* somatic hybrids and their backcross progenies by genomic in situ hybridization. Genome 42: 987-992. 1999.

79. Laferriere, L.T., Helgeson,J.P., and Allen, C. Developing bacterial wilt resistant breeding lines from *Solanum tuberosum - S. commersonii* somatic hybrids. Theor. Appl. Genet. 98:1272- 1278. 1999.

80. Polgar, Z., Wielgus, S.M., Horvath, S., and Helgeson, J.P.. DNA analysis of potato +*Solanum brevidens* somatic hybrid lines. Euphytica 105:103-107. 1999.

81. Dong, F., Song, J., Naess,S.K., Helgeson, J.P, Gebhardt C., and Jiang J.. Development and applications of a set of chromosome-specific cytogenetic DNA markers in potato. Theor. Appl. Genet. 101: 1001-1007. 2000.

82. Naess, S.K., Bradeen, J.M., Wielgus, S.M., Haberlach, G.T., McGrath,J.M., and Helgeson,J.P.. Resistance to late blight in *Solanum bulbocastanum* is mapped to Chromosome 8. Theor. Appl. Genet. 101: 697-704. 2000.

83. Dorance, A.E., Inglis, D.A., Helgeson, J.P., and Brown C.R. Partial resistance to *Phytopththora infestans* in four *Solanum* populations. Amer. J. Potato Research 78:9-17. 2001.

84. Dong, F., McGrath, J.M., Helgeson, J.P., and J. Jinag,J. The genetic identify of alien chormosomes in potato breeding lines revealed by sequential GISH and FISH analyses using chromosome-specific cytogenetic DNA markers. Genome 44:729-734. 2001.

85. Naess, S.K., Bradeen, J.M., Wielgus, S.M., Haberlach, G.T., McGrath, J.M., and Helgeson, J.P. Analysis of introgression of *SolanuM bulbocastanum* DNA into potato breeding lines. Mol. Gen. Genomics. 265:694-704. 2001.

86. McGrath, J.M., Williams, C. E., Haberlach, G. T., Wielgus, S. M., Uchytil, T. F., and Helgeson, J. P. Introgression and stabilization of *Erwinia* tuber soft rot resistance in

potato after somatic hybridization of *Solanum tuberosum* and *S. brevidens.* Amer. J. Potato Res. 79: 19-24. 2002.

87. Song, J., Bradeen, J.M., Naess, S.K., Raasch, J.A., Wielgus, S. M., Haberlach, G. T., Liu, J, Kuang, H, Sustin-Phillips, S., Buell, C.R., Helgeson, J.P., and Jiang, J. Gene RB cloned from Solanum bulbcastanum confers broad specturm resistnace to potato late blight. PNAS 100:9128-9133. 2003.

88. J. M. Bradeen, J.M., Naess, S.K. Song, J., Habrlach, G.T., Wielgus, S.M., Buell, C. R., Jiang, J. and Helgeson, J.P. Concomitant reiterative BAC walking and fine genetic mapping enable physical map development for the broad-spectrum late blight resistance region, RB. MGG. 269:603-611. 2003